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Review Article

Therapeutic Potential of Curcumin in *Curcuma longa*

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ABSTRACT

Curcumin is a polyphenolic active ingredient found in the Curcuma Longa plant (Turmeric). It is a member of the *Zingiberaceae* family. Turmeric and its compounds are used to treat a variety of diseases in underdeveloped nations because to their low cost. It's a common ingredient in herbal medicine. As an antioxidant, antifungal, antibacterial, anti-inflammatory, and anti-cancer agent, it has a lot of promise. Diabetes mellitus, arthritis, diabetic microangiopathy, gastro-intestinal illness, psoriasis, diabetic nephropathy, anxiety, bacterial infection, hyperlipidemia, acute cardiac disease and inflammation are only of few the disorders and symptoms for which it is very helpful. Although curcuma longa is safe to use and has no negative effect or any toxic response on human health, it is best known for its positive effect in reducing infertility, lowering blood glucose level, reduce bleeding issue and heavy menstruation in some people. Curcumin is an anti-oxidant that played a vital role in the prevention of many illnesses.

INTRODUCTION

Turmeric *(Curcuma longa L.)* belongs to the ginger family *Zingiberaceae* [1]. Curcuma longa has been used in Ayurvedic and Chinese medicine for a long time as a traditional medicinal system for the treatment of liver and digestive problems. Turmeric was used in Ayurvedic medicine to treat inflammatory issues [2]. Turmeric has been utilized for tissue regeneration, rheumatic disorders, gastrointestinal issues, deworming, rhinitis, and as a cosmetic in Indian traditional medicine [3]. Turmeric is used for a variety of medicinal and commercial purposes. As socio-religious "markings," South Asian women typically smear its red alkaline form on their cheeks and feet. It's used to treat skin disorder, inflammation, burn and wound as well as mouth soreness. It also helps also helps to revitalize the skin's appearance and prevent infection. Turmeric essential oil is used in scents and it had a long history of usage as a vibrant yellow fabric [4].

Curcumin and Curcuminoids

Turmeric is also known as curcumin longa; it contains polyphenolic compound called curcumin. It is proved from researches that it targets several signaling molecules and displayed an action at cellular level, that results in several health advantages [5]. It has been shown to aid with inflammatory illnesses, metabolic syndrome, and discomfort, as well as inflammatory and degenerative eye diseases. It also has a positive impact on the kidneys, and it has a variety of therapeutic effects as a supplement, most of which are connected to its antioxidant and anti-inflammatory properties [6]. The curcuminoids group of chemicals, which includes curcumin (diferuloylmethane), demethoxycurcumin, and bisdemethoxycurcumin (BMC), are major chemical components of Turmeric. Curcumin, which makes up 3.14 percent of powdered Turmeric, is the most researched compound [7]. Curcumin is utilized as an addition because of its thermal and dry food stability. In case of phosphate, chlorides and bicarbonate it is not reactive, but it can create salt with citrates and phthalates. Curcumin longa is insoluble in water when it is at acidic or neutral pH, however it becomes soluble in water when water is at alkaline pH and soluble in oils. Curcumin color is affected by different pH levels, it becomes vivid yellow between 2.5 – 7.0 pH and become red above 7.0 pH [8].

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Metabolism of curcumin

Curcumin metabolism is important because of its powerful health effects and biological activity. Curcumin may be found in three different states in the mammalian body: conjugated, free, and reduced. Curcumin in conjugated curcumin is metabolized mostly by glucuronidation and sulfation after oral dosing. According to the findings in humans, the gastrointestinal tract is crucial for the glucuronidation of curcuminoids [9]. Furthermore, intraperitoneal injection causes curcumin to be reduced into dihydrocurcumin and tetrahydrocurcumin, Curcuminoids' glucuronidation is aided by this enzyme in humans. Curcumin is also reduced into dihydrocurcumin, tetrahydrocurcumin, and hexahydrocurcumin after intravenous or intraperitoneal injection. Curcumin has anti-inflammatory properties stem as a result of its capacity to modify NFB (transcription factor). Curcumin extends the lifetime of model organisms and reduces the signs of aging [10].

Therapeutic Effects/ Health Benefits

The following diagram depicts the many therapeutic benefits of curcumin (Figure 1):

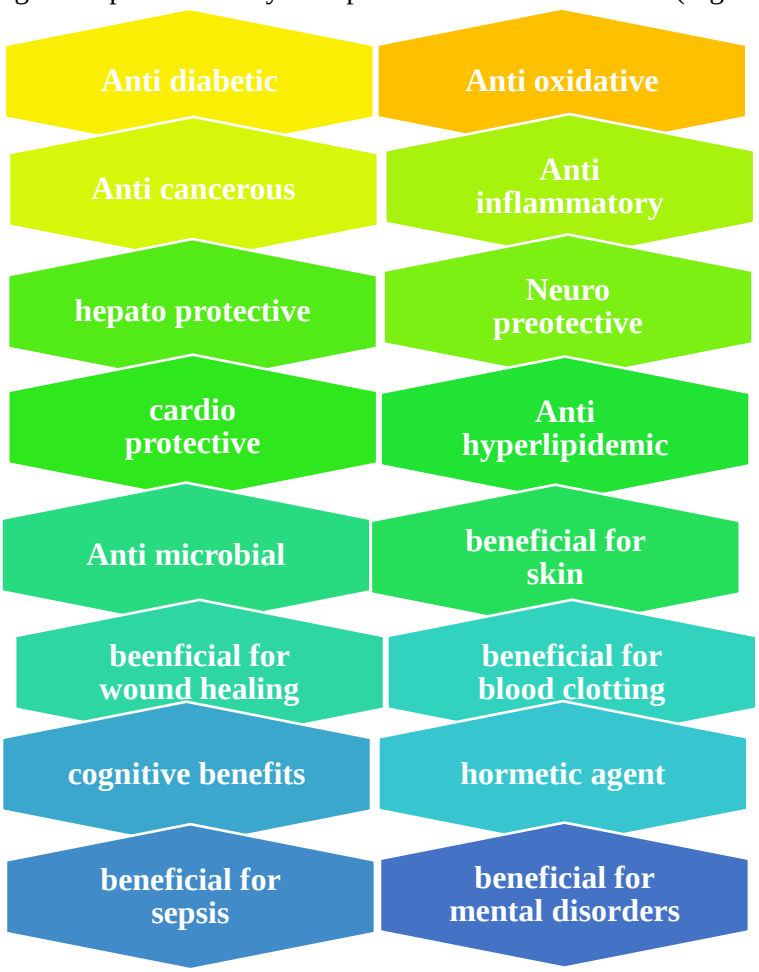

Figure 1: Health Benefits of Curcumin

Anti-cancer effect:

Environmental and nutritional variables can promote inflammation-driven disorders, including cancer. Many compounds found in fruits and vegetables are naturally occurring anti-oxidants and had shown to reduce oxidative stress, reduce nitrosamine synthesis, dilute and bind carcinogens in the digestive tract, and protect cells against malignant transformation. Curcumin is an epigenetic modulator, which was recently discovered. Curcumin inhibits the proliferation of malignant and tumor cells and has anti-cancer properties [11]. Colorectal cancer (CRC) is the third most common cancer in the world, after lung and breast cancer, and the second largest cause of cancer mortality, as per the World Health Organization (WHO) (2018). Traditional cancer treatment procedures used across the world include radiation, chemotherapy, and surgery. Natural substances such as curcumin (CUR), resveratrol, lycopene, gingerol, and folate have recently gained popularity as chemopreventive agents with little adverse effects. Curcumin is used to treat a variety of malignancies, including colorectal,

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pancreatic, breast, prostate, lung, and oral cancers, either alone or in combination with other natural substances [12]. On the survival of a human epidermoid carcinoma cell line (A431 cells), the effects of curcumin-reduced AgNPs (C-AgNPs), l-tyrosine-reduced AgNPs (T-AgNPs), and free curcumin were compared. When compared to free curcumin at greater concentrations (60 g/mL), C-AgNPs and T-AgNPs are hazardous to skin cancer (A431) cells. C-AgNPs' anticancer activity implies that it might be employed as a cancer chemotherapeutic drug [13].

Curcumin as wound healing agent:

Curcumin act as antioxidant and anti-inflammatory agent which helps to the body to repair wound at different stages of the healing process. Curcumin is a powerful antioxidant that prevents lipid oxidation, reduces oxidation, and lessens the effects of oxidative stress via enzymatic and non-enzymatic processes [14]. In the proliferation stage, numerous cells such as fibroblasts and macrophages migrate towards the wound side, and neovascularization boosts collagen production and tissue growth. It aids in converting growth factor and increasing manufacture of extracellular matrix (ECM) in the last stage of remolding, which might promote wound constriction. Curcumin inhibits the development of Pseudomonas aeruginosa. Curcumin has been proven to have a favorable effect on wound healing in rats, even in the case of burns [15].

Anti-microbial effect:

Curcumin has been proven to have antimicrobial properties against microorganisms that cause infectious diseases. Curcumin has recently been found to have inflammatory characteristics like as chemokine, cytokine and toll-like receptor (TLP) PCR tests in rats with H.pylori infection [16]. Curcumin defends against a wide spectrum of threats of microbes including Streptococcus mutans, E.coli, Pseudomonas aeruginosa, Shigella dysenteriae, Streptococcus epidermidis, Bacillus subtilis and others. Curcumin contains antimicrobial compounds called desmethoxycurcumin and curcuminoids [17].

Curcumin as a Cardio-Protector:

As a Cardio-Protector, Curcumin has been shown to be effective. Cardiac disorders are currently the leading cause of mortality in the United States. Curcumin has an impact on a variety of cardiac pathogenic processes. By reducing cholesterol serum and fat (LDL), it helps to prevent myocardial infarction and atherosclerosis. It protects against heart disorders by increasing calcium transfer from the heart muscles [18]. Curcumin protects against heart failure by decreasing p300-HAT. Curcumin's cardiac-protective ability has been demonstrated in several research. Curcumin reduces the risk of heart failure by decreasing sodium fluoride toxicity, according to a study [19]. Cardiomyocytes, cardiac hypertrophy, oxidative stress, and a variety of inflammatory processes are all targets for it. According to research, it lowers HDL levels by 29%, serum lipid levels by 33%, and cholesterol levels by 12% in the body. It protects the heart in this way [20].

Anti-diabetic properties:

Curcumin decreases blood glucose consistency via increasing the activities of insulin and LPL. Curcumin can impact gluconeogenesis, glycolysis, and lipid metabolism. When curcumin is combined with vitamin C and yogurt, blood glucose, hemoglobin (Hb), and HbA1C levels drop, as does weight. Curcumin use is also connected to a lower lymphocyte penetration rate and smaller pancreatic islets [21]. Curcumin's anti-diabetic properties have been demonstrated in animal models in a number of minor studies. Curcumin's anti-diabetic mechanism has recently been addressed in a number of research. Many of the effects of curcumin can be explained by insulin titillation, as demonstrated in diabetic rats fed with a curcumin and yogurt combination, such as reduced glycemia and glycosuria, increased adipose muscle tissue weight, and reduced food intake when compared to rats treated simply with yogurt [22].

In the case of type 1 diabetes:

Curcumin has anti-diabetic properties at small dosages. Curcumin and its derivatives have an impact on the body's oxidative state and lipid levels. Curcumin also helps to manage blood glucose levels by lowering lipid levels in the liver and pancreas, according to studies. On rats, the results demonstrate a rise in plasma insulin of 66.6 percent and a drop in plasma glucose of 27.5 percent. Diabetes-related symptoms such as increased thirst, eyesight loss, nerve damage, weight loss, and wound healing can all be alleviated by boosting insulin output [23].

In the case of type 2 diabetes:

Curcumin improves the activity of pancreatic beta cells. It reduces the HOMA-IR level while increasing the adiponectin level, according to an experimental investigation. Many studies show that it might also be used to treat pre-diabetes [24].

An anti-hyperlipidemic agent

Atherosclerosis and atherosclerosis-induced coronary heart disease are primarily caused by hyperlipidemia and low HDL cholesterol levels (dyslipidemia). Hypercholesterolemia and metabolic disorders can be managed using Ayurvedic herbs. Curcumin can help prevent cholesterol from becoming oxidized. Curcumin raises HDL-C levels while lowering lipid profile levels. Hypercholesterolemia can also be treated with it. The WHO recommends a daily consumption curcumin as an additive has a dose range of 0–3 mg/kg body weight, However, at dosages as much as 12,000 mg/day, it was well accepted

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in human patients [25]. In rodent models, curcumin enhances lipoprotein metabolism by reducing LDL-C and TG levels while boosting HDL-C levels. HDL particles are thought to protect you against heart disease (CVD) mostly because of its function in reverse cholesterol transport (RCT) . In rat models, curcumin has been found to enhance lipoprotein metabolism by lowering LDL-C and TG while boosting HDL-C [26].

Curcumin as a Hormone Regulator:

Because of its biphasic dose response profile, it is effective in lowering stress response pathways, curcumin is known as hormetic. Hormesis is a dose response phenomenon characterized by low dose stimulation and large dose inhibition. The hormetic effects of curcumin on human tumor cells alter cell proliferation as well as endpoints that predict metastasis [27].

Oral Lichen Planus: Protective effect

Oral lichens planus (OLP) patients often take topical corticosteroids; however, they can promote mucosal atrophy and candidiasis. Curcumin is effective in curing lesions and OLP symptoms when given orally. In conjunction with corticosteroids, curcumin helps treat OLP and reduces burning sensation and discomfort [28]. Curcumin appears to have a beneficial impact in the prevention of chronic lichen planus, according to recent study findings. In one study, patients were given 80mg of curcumin capsules, which resulted in 80 percent of patients having better lesions, 10% having entirely healed, and 50% having reduced discomfort [29].

Protection against Ocular disease:

Curcumin has a strong antioxidant effect in oscular illness induced by oxidative stress through modulating protective miRs. Because the brain and retina are both made up of neural ectoderm, their degeneration may share miRs and other genetic and epigenetic variables. Curcumin's ability is owing to its phytochemical action on miRs [30].

Protection against Ovarian Failure:

Increased follicle-stimulating hormone (FSH) and reduced estradiol (E2) levels are associated with the loss of ovarian function in women under the age of 40. Curcumin has been shown to regulate gene expression and enzymatic activity of detoxification enzymes like NAD(p)H, as well as having a protective effect against Cyclophosphamide (CYC) in rats and effects on Ra ovaries, including reduced lipid peroxidation, antioxidant and anti-inflammatory effects, and improved histological parameters [31].

Cognitive advantages:

Curcumin has a low molecular weight and is polar, allowing it to flow across the blood-brain barrier. I reduce my chance of neurodegenerative diseases like Parkinson's and Alzheimer's by preserving cognitive function. Curcumin improves memory, brain function, and reduces oxidative damage via boosting brain-derived neurotropic factors [32].

Antioxidant properties:

Antioxidant property or aptitude refers to a cell's ability to prevent oxidation of oxidative substances such as carbohydrates, amino acids, lipids, and DNA damage. Curcumin has grown in importance as an antioxidant due to its wide variety of applications and medicinal benefits. Curcumin is a scavenger of free radicals and an inhibitor of DNA damage, especially when particles like as Cu or Fe ions are present. Curcumin is an ion supporter that affects antioxidant properties and radical scavenging actions [33]. Curcumin has an antioxidant impact by generating and regulating antioxidant proteins and mimicking reactive species such as peroxynitrite (NOO), nitric oxide (NO), peroxyl radicals (ROO), and hydroxyl (OH) radicals. The antioxidant properties of curcumin aid in the neutralization of free radicals that cause cell damage [34].

Protective impact against kidney disease:

Chronic renal failure has been related to an increased risk of cardiovascular problems. Curcumin has antioxidant properties by scavenging reactive oxygen species (ROS) directly and indirectly by promoting the production of cytoprotective proteins in a Nrf2-dependent manner. However, in certain people, curcumin consumption might lead to cardiac problems. Hemodialysis helps CRF patients by increasing free radical generation and lowering antioxidant defenses [35].

Role in Pulmonary diseases:

Many respiratory disorders, such as respiratory problems, COPD, pulmonary fibrosis, respiratory failure, and acute lung damage, are classified by abnormal inflammatory responses. Curcumin's unique effects on pulmonary fibrosis are due to its use of many routes and a variety of mechanisms. Curcumin has a role in pulmonary fibrosis by lowering TNF- and cyclo-oxygenase 2 (COX-2) levels as well as TGF-1 levels. This is due to NF-B inhibition, which has anti-fibrotic and anti-inflammatory effects [36]. Allergic rhinitis (AR) is characterized by nasal obstruction, rhinorrhea, sneezing, and nasal itching, all of which are caused by IgE-mediated inflammation of the nasal mucosa. In individuals with AR, curcumin dramatically reduced nasal symptoms such as allergies, irritation, rhinorrhea, and obstruction. The nasal airflow was also enhanced [37].

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Immunosuppressive Effect:

Curcumin's role in immunity may be divided into two categories: Innate and adaptive immunity are two types of immunity. Innate immunity is defined as a predictable, quick response that occurs before the formation of adaptive immunity's antigen-specific response. Curcumin affects immunological capabilities and function through altering the activity of immune cells such as neutrophils, macrophages, monocytes, T cells, B cells, and natural killer cells [38].

Beneficial effect on Skin:

Curcumin stimulates collagen synthesis and slows skin wound healing. Curcumin has been reported to be effective in the treatment of psoriasis, dermatitis, and scabies. 50 Curcumin's anti-inflammatory and anti-cancer properties make it useful in the treatment of skin cancer. Curcumin has been shown to inhibit the NFB pathway and control the activity of pro-apoptotic proteins in recent research. It acts as an anti-proliferative agent in melanoma cells and is beneficial against skin cancer [39]. Curcumin has been shown to be useful in the treatment of psoriasis. According to current study, curcumin functions as an anti-proliferative drug by activating pro-inflammatory cytokines such as tumor necrosis factor, interleukin-6 (IL-6) and (IL-17), and interferon-y. Curcumin activates filaggrin and involucrin, which improves skin barrier function (iNV) [40].

Protection from neurotoxic effects:

Neurodegenerative diseases (NDDs) are a growing public health concern across the world, exacerbated by an aging population in both industrialized and developing nations. The bulk of neurodegenerative disorders (NDDs), such as Parkinson's disease (PD), Alzheimer's disease (AD), and Huntington's disease (HD), remain incurable [41]. Many micro processes, such as increasing neuronal malfunction and death, are used to diagnose NDDs. Specific proteins accumulation, nitrosative stress, mitochondrial dysfunction, and proteotoxic stress as well as linked disorders in ubiquitin, lysosomal and proteasomal, apoptosis, excitotoxicity, cell death and uncontrolled neuroinflammation are all the examples of these disease [42]. Curcumin has a preventive role against chemical medicines that cause organ toxicity, such as VCR, PTZ, SEVO, and STNP, due to its therapeutic actions. Autophagy is essential for cellular homeostasis and is consequently present in a variety of cell types. Autophagy malfunction has been implicated in the etiology of Parkinson's disease in studies. Curcumin therapy reverses the disease by reducing the amount of A53T-synuclein and restoring macroautophagy through the decrease of mTOR or p70S6K signaling. Curcumin therapy activates several molecules and genes in the autophagy system, restoring autophagy in Alzheimer's disease mice [43]. The usage of cisplatin, a platinum-based chemotherapy, has been related to a number of side effects that have a negative impact on a person's quality of life. Cisplatin therapy is endangered by a slew of resistance issues, many of which increase the drug's capacity to operate. Curcumin has been utilized to combat cisplatin-resistant cancer cells and reduce its major side effects like as ototoxicity, nephrotoxicity, and neurotoxicity in order to complete these aspects of cisplatin therapy [44].

Anti-inflammatory property:

Curcumin is well-known for its anti-inflammatory effects, which aid in the treatment of chronic inflammation in conditions including arthritis, gastrointestinal disease, cardiovascular disease, cancer, and diabetes. It has the capacity to inhibit the action of enzymes involved in the inflammatory cascade. It relieves rheumatoid arthritis symptoms such as stiffness, discomfort, and edema [45].

Beneficial for blood clotting:

Herbal medications have long been used to treat heart disease and can aid in modulating its course, notably in hemostasis and coagulation, as well as changing platelet function tests and certain coagulation markers [46]. Curcumin reduces platelet accumulation in the circulation by inhibiting the synthesis of thromboxanes, which leads to clot formation in pulmonary embolism, stroke, and deep vein thrombosis. Curcumin is anti-thrombotic and anti-fibrotic in nature. Because of the hydrophobic group, it prolongs clotting time in several routes such as PT, APTT, and PT. Curcumin and BDMC have antithrombotic properties, according to the findings, and regular use of the curry spice turmeric may help maintain anticoagulant state [47].

Beneficial for Spinal cord injury:

Spinal cord injury (SCI) is a devastating occurrence that has far-reaching social and economic consequences for the sufferer. Curcumin has recently emerged as a possible therapeutic medication in the treatment of SCI. Curcumin treatment can significantly reduce edema in the damaged spinal cord. Curcumin has been proven in several trials to have a therapy effect in SCI by preserving neurons and decreasing oxidative and inflammatory processes [48]. Curcumin protects rats from spinal damage by reducing malondialdehyde levels and increasing serum superoxide dismutase levels. Curcumin reduces malondialdehyde levels while increasing glutathione peroxidase and superoxide dismutase levels, preventing spinal damage, according to new study [49].

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Role in Sepsis:

Sepsis is a life-threatening condition caused by a weakened immunological response to infection in the host. In humans, disorders including inflammatory bowel disease, metabolic syndrome, and rheumatoid arthritis have demonstrated modifications due to curcumin's potential involvement in modulating the immune response [50]. As a result, these consequences can be seen in sepsis. Curcumin's therapeutic benefits on sepsis have been simulated in animal models and cell lines, according to certain research. Curcumin has an inhibitory impact on the problem caused by sepsis [51].

Benefits against mental disorders:

Curcumin relieves anxiety and depression symptoms by reducing interconnected symptoms. Curcumin raises the amount of the fatty acid Omega-3, which promotes brain growth. Curcumin consumption has been associated to higher levels of brain derived neurotrophic factor in preclinical investigations (BDNF). Curcumin's effects on BDNF and neurocognition are also important for schizophrenia, with decreased levels of BDNF and a neurocognitive deficit [52]. Increased inflammatory response, oxidative stress, and aberrant neuronal pruning are all associated to the development of schizophrenia. A medication that activates one or more of them by increasing BDNF levels, can prevent disease-affected processes such as poor learning, memory, and neuroplasticity [53]. Autism spectrum disorder is a multi-syndrome condition that impacts brain development. Less social interest, depression, irritable disposition, hostility, seizures, and sensory processing illness shown as repetitive and stereotypic behavior are the main signs of ASD. Curcumin also helps to keep MMP-9 in blood mononuclear cells in check. One of the most common causes of ASD is anxiety. Curcumin is also useful in the development of a therapeutic molecule for the treatment of autism. Curcumin is said to aid GABergic, an anti-anxiety hormone [54].

Role in Gut micro biota:

Many metabolic disorders, such as obesity, diabetes, and chronic liver disease, are associated to changes in the intestinal microbiota, and the intestinal microbiota has been proposed as a novel possible therapeutic target for these microbiota and related diseases. The abundance of various members in the gut microbial communities of rats is affected by curcumin metabolism. Given the recent growth in research supporting the pathogenic link between gut microbiota and many diseases, particularly changes in many specific bacteria in diseases in the control of effects in gut microbiota, which may contribute in part to curcumin's therapeutic advantages [55].

Hepato-protective effect:

Infections of the liver, as well as viral infections, are on the rise. The antiviral action of Curcuma longa rhizome aqueous extract in HBV in HepG cells having HBV genomes demonstrates that HBsAg production from liver cells occurs without any harmful side effects. It also reduces the generation of HBV residues and the quantity of HBV mRNA in infected cells. Curcuma longa extract reduces HBV duplication by raising the quantity of protein p53, improving protein stability, and transactivating the p53 gene transcription [56]. One of the most common complications of hepatic surgery and transplantation is liver reperfusion or damage. Curcumin's anti-inflammatory, oxidative stress-reducing, and adhesion-molecule-reducing qualities have been associated to liver improvement in several investigations. Oxidative stress is a pathway implicated in liver damage, and curcumin specifically targets it by enhancing antioxidant enzymes, lowering ROS, and improving RNA scavenging. Curcumin exhibits photodynamic therapy and boosts anti-tumor effects in epithelial liver cancer cells (HC-AFW1, HUH6, HepT1 and HepG2) by promoting viability loss via ROS generation [57].

NAFLD:

The most prevalent cause of chronic liver injury is nonalcoholic fatty liver disease (NAFLD), which is also connected to liver damage ranging from steatosis to nonalcoholic steatohepatitis [58].

Alcoholic Liver Disease:

Hepatitis and hepatic fibrosis risk increase with daily alcohol use (20 g for females and 60-80 g for males). Curcumin has been identified as a protective agent against alcoholic liver damage in studies. Curcumin supplementation can help to reduce inflammation, fatty liver, and necrosis. Curcumin reduces oxidative stress and lipid peroxidation while also stimulating NF-kB and TNF-, IL-12, MCP-1, MIP-2, COX-2, and iNOS expression [59].

Role in metabolic syndrome:

A metabolic disorder occurs when several metabolic abnormalities occur in a person at the same time. The feelings of stomach discomfort and flatulence are frequent in patients with inflammatory bowel illness (IBS), and changing these habits may assist to reduce the frequency of defecations. Curcumin is a natural pain reliever that clears the liver of numerous toxic compounds. It also maintains metabolic function and aids in weight reduction. Curcumin has an anti-fibrous action that can be used to treat liver fibrosis [60]. Curcumin supplementation (1 g/day for 30 days) is also helpful in the treatment of dyslipidemia in obese patients, resulting in a considerable increase in blood TG concentrations. Curcumin administration

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has been shown to reduce liver fat content, BMI, and blood levels of total cholesterol, LDL, glucose, and HbA1c in those suffering from nonalcoholic fatty liver disease and Metabolic syndrome [61].

Side effects of curcumin consumption:

Excess curcumin consumption causes low blood sugar, bleeding-related illnesses, increased menstruation, and poor fertility. It can also cause anemia because it reduces iron absorption. Excessive uterine contraction is another negative effect of curcumin toxicity or overdose in pregnant women, which can lead to abortion [62]. Other side effects include nausea, diarrhea, and headache, as well as an increase in lactate dehydrogenase and serum alkaline phosphatase. Mild gastrointestinal symptoms (such as dyspepsia, meteorism, bloating, and gastroesophageal reflux), loose stool, constipation, increased stool frequency, and hot flashes are all possible side effects [63].

CONCLUSION

Finally, at the end it is concluded that curcumin act as an oxidative and anti-oxidant, Curcumin aids in the reduction of oxidative stress. As a result, it aids in the recovery of a wide range of acute and chronic diseases, including arthritis, diabetes, diabetic microangiopathy, diabetic nephropathy, liver disease, psoriasis, cardiac arrest, hyperlipidemia, inflammation, gastro-intestinal disease, anxiety, bacterial infection and liver diseases. It has a lot of medicinal and therapeutical benefits, for a common household product in many South Asian homes.

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